JHR 28: 85–121 (2012)
doi: 10.3897/JHR.28.3484
www.pensoft.net/journals/jhr

RESEARCH ARTICLE

JOURNAL OF Hymenoptera RESEARCH
A peer-reviewed open-access journal
The International Society of Hymenopterists

Colastomion Baker (Braconidae, Rogadinae): nine new species from Papua New Guinea reared from Crambidae

Donald L.J. Quicke[1,2,†], M. Alex Smith[3,‡], Scott E. Miller[4,§], Jan Hrcek[5,|], Buntika Butcher[6,¶]

1 *Department of Biological Sciences, Imperial College London Silwood Park Campus, Ascot, Berkshire SL5 7PY, UK* **2** *Department of Entomology, The Natural History Museum, London SW7 5BD, UK* **3** *Department of Integrative Biology & the Biodiversity Institute of Ontario, University of Guelph, Guelph, Ontario N1G 2W1, Canada* **4** *National Museum of Natural History, Smithsonian Institution, PO Box 37012, MRC 105 Washington, DC 20013-7012, USA* **5** *Faculty of Science, University of South Bohemia and Biology Center, Czech Academy of Sciences, Branisovska 31, 37005 Ceske Budejovice, Czech Republic* **6** *Department of Biology, Faculty of Science, Chulalongkorn University, BKK 10330, Thailand*

† *urn:lsid:zoobank.org:author:4FAA3C17-13D3-467B-AAA5-82B27FE783EF*
‡ *urn:lsid:zoobank.org:author:E46EE6EB-E096-4FCD-BF5A-F91D4A8294EE*
§ *urn:lsid:zoobank.org:author:D70079F1-5135-46BA-A790-CB833B5892EF*
| *urn:lsid:zoobank.org:author:31771CB4-A88A-4BF6-ACF0-28F9564D2692*
¶ *urn:lsid:zoobank.org:author:3AC486D1-9045-44FB-9FE4-FF71A0C2909C*

Corresponding author: *Dr. Donald L. J. Quicke* (d.quicke@imperial.ac.uk)

Academic editor: *Gavin Broad* | Received 7 July 2012 | Accepted 13 August 2012 | Published 24 August 2012

urn:lsid:zoobank.org:pub:1352252C-D511-44A1-A2D0-B74E00C7D616

Citation: Quicke DLJ, Smith MA, Miller SE, Hrcek J, Butcher B (2012) *Colastomion* Baker (Braconidae, Rogadinae): nine new species from Papua New Guinea reared from Crambidae. Journal of Hymenoptera Research 28: 85–121. doi: 10.3897/JHR.28.3484

Abstract

Nine new species of *Colastomion* Baker are described, illustrated and keyed based on series of specimens reared from caterpillars of crambid moths from lowland Papua New Guinea plus one additional field collected specimen, viz. *C. cheesmanae* Quicke **sp. n.**, *C. crambidiphagus* Quicke **sp. n.**, *C. gregarius* Quicke **sp. n.**, *C. maclayi* Quicke sp. n., *C. madangensis* Quicke **sp. n.**, *C. masalaii* Quicke **sp. n.**, *C. parotiphagus* Quicke **sp. n.**, *C. pukpuk* Quicke **sp. n.** and *C. wanang* Quicke **sp. n.** Most species are morphologically easily distinguished but DNA barcoding additionally reveals a pair of exceedingly similar species (*C. pukpuk* **sp. n.** and *C. maclayi* **sp. n.**) that might otherwise have gone unrecognised. The new species each appear to be relatively specialised on their host species and all parasitize only caterpillars of Lepidoptera: Crambidae: Spilomelinae.

Copyright *Donald L.J. Quicke et al.* This is an open access article distributed under the terms of the Creative Commons Attribution License 3.0 (CC-BY), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Keywords
cytochrome oxidase I, DNA barcoding, Lepidoptera, hosts, Rogadini, Crambidae

Introduction

Colastomion Baker (1917) is a relatively uncommon genus of rogadine parasitic wasp that occurs throughout the southern East Palaearctic, S. E. Asia and Africa. It belongs to a group of genera which additionally includes the tropical Old World genera *Cystomastacoides* van Achterberg, *Macrostomion* Szépligeti, *Megarhogas* Szépligeti and *Myocron* van Achterberg (1991) all of which share a more or less deep and ventrally strongly curved hypopyium with a strongly down-curved ovipositor (also present in various other SE Asian genera). Until recently nothing was known about its biology though *Macrostomion* has been reared from various Sphingidae caterpillars within which it is gregarious with 20–50 individuals typically emerging from a single mummified host larva (Shaw 2002, Maeto and Arakaki 2005).

To date, only six species of *Colastomion* have been described, viz. *C. abdominale* Baker (1917) from the Philippines, *C. bicoloricorne* (Granger 1949) from Madagascar, *C. concolor* (Szépligeti 1911) originally described from Tanzania and subsequently reported from Democratic Republic of Congo, Madagascar, Malawi and Togo (Yu et al. 2005), *C. formosanum* Watanabe (1932) originally described from Taiwan, but recently recorded from Japan (Tenma 2002), *C. nigricorne* (Granger 1949) and *C. tristis* (Granger 1949) both from Madagascar.

Here we describe nine new species of *Colastomion*, eight of which are based on reared specimens from caterpillars feeding on various trees and shrubs in lowland Papua New Guinea. These were obtained during an extensive caterpillar collecting and rearing programme which has additionally yielded a number of other interesting rogadine parasitoids including the recently described, highly distinctive genus *Vojtechirogas* Quicke & van Achterberg (Quicke et al. 2012).

The host records for some of the species include a degree of fuzziness because identifications are based on caterpillar morphology. The actual parasitized caterpillars of course never produce an adult moth, and so there is always some degree of uncertainty with host records acquired by rearing. Because in the course of the New Guinea rearing programme there were several hundred thousand caterpillars reared, we are able to quantify the inevitable uncertainty. For any reared specimen we present only host records which are at least 95% sure, i.e. at least 95% of the tens or hundreds of moth adults reared from the same combination of caterpillar morphotype and host plant as the parasitoid agree with the reported host identification. Two rearing records for *C. masalaii* sp. n. and *C. parotiphagus* sp. n. were confirmed by sequencing host remnants (Hrcek et al. 2011).

The systematics of several of the moth taxa involved here, all of which belong to the crambid subfamily Spilomelinae, is also far from complete and there is no meaningful phylogeny as yet. Thus some genera may well be poly- or paraphyletic assemblages, and in these cases we have sometimes been able to assign hosts to species groups, that in the future may shift into other generic combinations.

Terminology

Terminology follows van Achterberg (1979, 1988). Measurements of the height and horizontal length of the eye are approximations because the very bulbous face and very large eyes make it difficult to measure consistently; in our attempts to do so, the head was orientated so that the face (defined as running from the anterior edge of the toruli to the dorsal margin of the clypeus) was horizontal or perpendicular to the measurement axis.

Abbreviations: NHM (The Natural History Museum, London); USNM (United States National Museum, Washington D.C.). Note, some paratypes will be repatriated to PNG when analysis is complete.

Methodology

Phylogenetic inference and bar-coding discrimination of species were based upon maximum likelihood (ML) analysis of approximately 657 base pairs of the 5' end of the mitochondrial cytochrome oxidase I gene, using the programme *RAxML* (Stamatakis 2006) with the *GTRGAMMA* model and using a sequence from the related genus *Myocron* van Achterberg as outgroup. DNA sequencing was performed at the Biodiversity Institute of Ontario, University of Guelph, using their standard methods (Hrcek et al. 2011).

Most specimens were imaged using Cell^D® imaging facility. *C. gregarious* sp. n. and *C. cheesmanae* sp. n. were imaged using a Canon EOS 7D camera, Adobe Lightroom software and edited using Adobe Photoshop CS4.

Results

DNA barcodes were generated from all but one of the species described below, the exception being a nearly 80 year old specimen found in the NHM collection. Fig. 1 shows a ML tree from these, with eight clearly separated molecular species, and intraspecific variation was limited to two individuals of *C. masalaii* sp. n. (vouchers USNM ENT 00503254 and 00643295) differing from the remainder at a single base position.

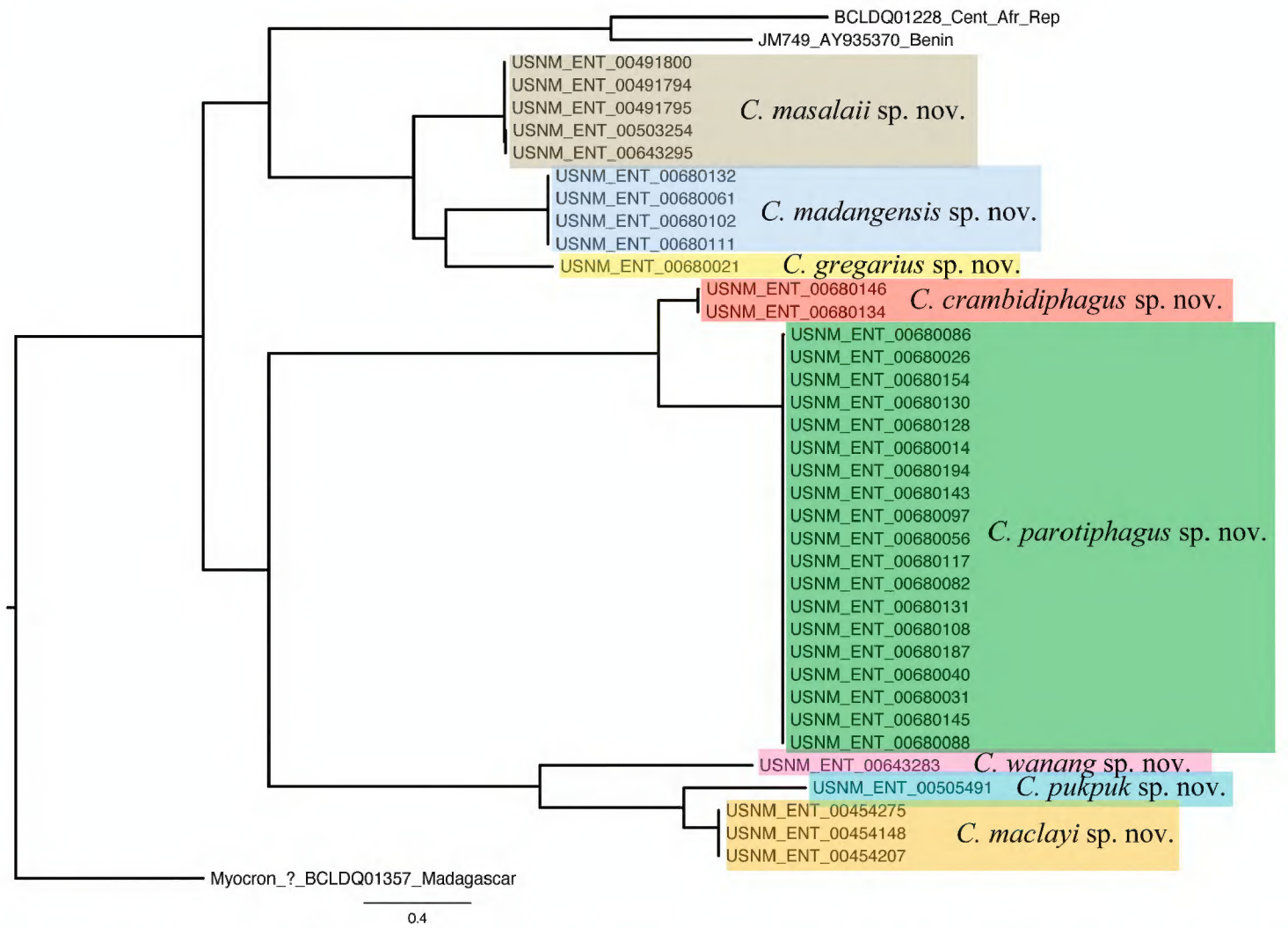


Figure 1. Maximum likelihood tree (using GTR+G parameter model) of the reared and barcoded species of *Colastomion* (final Gamma –based likelihood -2578.386754).

Systematics

Key to species

1 Fore wing vein cu-a antefurcal (Figs 5, 15, 21); propodeum with short mid-longitudinal carina anteriorly, giving rise to a midlongitudinal depression with transverse crenulae or transverse rugosity (Fig. 7); antenna with fewer than 42 [31–39] flagellomeres (Fig. 2); hind wing vein M+CU shorter [0.6–0.9 ×] than 1-M; largely yellow or yellow brown, metasoma the same colour as mesosoma **2**

– Fore wing vein cu-a postfurcal; propodeum with a complete midlongitudinal carina or if incomplete, replaced by rugosity on posterior half; antenna with more than 43 [45–57]; flagellomeres; hind wing vein M+CU longer [1.1–2.5 ×] than 1-M; colour variable, sometimes metasoma black and cream contrasting with yellow-brown mesosoma **4**

2 Antenna with fewer than 35 [32] flagellomeres (Fig. 2); 3rd segment of female maxillary palp distinctly swollen, approximately 4.5 × longer than maximally

wide; pterostigma entirely pale yellow (Fig. 2); mesosoma brown yellow dorsally with posterior of pronotum, mesopleuron, mesosternum and metapleuron whitish (Fig. 4) ..... ***C. gregarius* sp. n.**

– Antenna with more than 35 [37–40] flagellomeres; 3rd segment of female maxillary palp slender, approximately 7 × longer than maximally wide; pterostigma either bicolorous (Fig. 21) or entirely dark grey (Fig. 15); mesosoma unicolorous, either entirely pale yellow or brown yellow (Fig. 13) **3**

3 Pterostigma largely dark brown; antenna largely dark brown (Fig. 15); fore wing vein cu-a strongly inclivous (Fig. 15) ..... ***C. masalaii* sp. n.**

– Pterostigma bicolorous, cream on basal 0.3 and on anterior margin, remainder brown (Fig. 21); antenna cream coloured; fore wing vein cu-a vertical (Fig. 21) ..... ***C. madangensis* sp. n.**

4 Metasoma almost entirely brown-yellow, sometimes with basal grooves of tergites brown medially (Figs 29, 30); 5th segment of female maxillary palp less than 0.6 [0.5 ×] 6th segment (Fig. 32) **5**

– Metasomal tergites 3–4 largely black (Figs 39, 47, 51, 52); 5th segment of female maxillary palp more than 0.6 [0.7–0.9 ×] 6th segment (Fig. 54) **6**

5 Flagellum entirely yellow; metasomal tergites 3–5 pale yellow with distinctly brown yellow mark narrowly mediobasally, tergite 6 somewhat more extensively brown yellow medially (Fig. 29) ..... ***C. crambidiphagus* sp. n.**

– Flagellum black on basal half becoming paler, sometimes yellow, from about middle to shortly before tip, contrasting strongly with pale yellow scapus and pedicellus (Fig. 31); metasomal tergites more or less evenly coloured pale yellow (Fig. 30) ..... ***C. parotiphagus* sp. n.**

6 Fore wing vein M+CU thickened up to near its middle and sharply narrowing and curved beyond this (Figs 41, 42) ..... ***C. wanang* sp. n.**

– Fore wing vein M+CU more or less evenly thick and straight or only weakly curved (Figs46, 50, 52) **7**

7 Anterior of propodeum strongly sculptured, rugose (Fig. 47, see also Fig. 38); 2nd subdiscal cell rather widened distally, maximum length of cell membrane < 3.5 [3.1] × maximum width (see Fig. 41)..... ***C. cheesmanae* sp. n.**

– Anterior of propodeum on either side of midlongitudinal carina largely smooth with punctures or at most with narrow crenulated groove next to carina (Figs 49, 54); 2nd subdiscal cell long and narrow, maximum length of cell membrane < 3.7 [4.0] × maximum width (Fig. 50) **8**

8 1st tergite in lateral profile distinctly deeper near midlength (Fig. 55)..... ..... ***C. pukpuk* sp. n.**

– 1st tergite in lateral profile deepest on anterior third and behind this flat or weakly depressed (Fig. 56) ..... ***C. maclayi* sp. n.**

Descriptions of new species

***Colastomion gregarius* Quicke, sp. n.**
urn:lsid:zoobank.org:act:6C64E6C5-8CB9-48B3-9A92-1475E7779B24
http://species-id.net/wiki/Colastomion_gregarius
Figs 2–8

Material examined. Holotype female, Papua New Guinea, Madang Province, Wanang, 24-May-07, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar on *Ficus variegata* Blume (Moraceae) (voucher USNM ENT 00680021; BOLD ASQSP084-08; Genbank JF963128) [furthest specimen from pin on topmost card] (USNM)

Paratypes. 4 males and 3 females, 1 unknown (missing metasoma), rest of reared series from the same parasitized host, mounted on total of 3 cards and on same pin as holotype. (USNM).

Morphology. Length of body 4.0–4.8 mm, of fore wing 3.0–3.6 mm and of antenna 5.1–5.2 mm.

Head. Antenna with 31–32 flagellomeres. Terminal flagellomere acuminate. Median flagellomeres approximately 2 × longer than wide. 3rd segment of maxillary palp of female weakly swollen, approximately 4.5 longer than maximally wide. 5th segment approximately same length as 6th. Base of mandible well removed from eye, closest point approximately 1.3 distance from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 2.7 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 2.25 : 1.3. Face rather shiny, with fine transverse striation laterally above level of clypeus. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 1.2 : 1.4. Occipital carina broadly obliterated or extremely weak mediodorsally

Mesosoma. Notauli narrow, moderately impressed, crenulated. Mesoscutum longitudinally striate-rugulose at confluence of notauli. Mesopleuron largely smooth and shiny. Precoxal sulcus deeply impressed and strongly crenulate. Propodeum with very short midlongitudinal carina anteriorly that splits giving rise to pair of weak carinae bordering a widening midlongitudinal depression with moderately well developed transverse striation. Propodeum with distinct mediolateral projections.

Fore wing. Vein 1-CU1 antefurcal. Vein 2-CU1 6.0 × longer than 1-CU1. Vein 1-M weakly curved. Lengths of veins SR1: 3-SR: r = 6.0: 2.7 : 1.0. Vein 2-SR 1.0 × 2-SR+M.

Hind wing. Vein M+CU 0.9 × length of 1-M. Vein 2-SC+R thickened and distinctly inclivous. Vein SR moderately strongly curved on basal half, almost reaching wing margin approximately half distance to wing tip, then running more or less parallel to wing margin.

Metasoma. 1st metasomal tergite 1.7 × longer than posteriorly wide. 2nd metasomal tergite 1.6 × wider than long, with wide midbasal triangular area giving rise

Figures 2–5. *Colastomion gregarius* sp. n. light photomicrographs. **2** Habitus, lateral view **3** face **4** head and mesosoma, lateral view **5** basal venation of fore wing.

to weak midlongitudinal carina; rather weakly irregularly longitudinally striate with approximately 7 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.9 × wider than long; weakly irregularly longitudinally rugulose-striate basally and medially. 4th - 6th tergite s smooth.

Coloration. Body, legs, wing venation and antennae largely pale ochreous yellow with malar region, posteroventral part of pronotum, propleuron, mesopleuron and mesosternum, metapleuron, sides of tergites 2–6 and fore and mid coxa, trochanter and trochantellus whitish; terminal 6 or 7 flagellomeres dark grey-black.

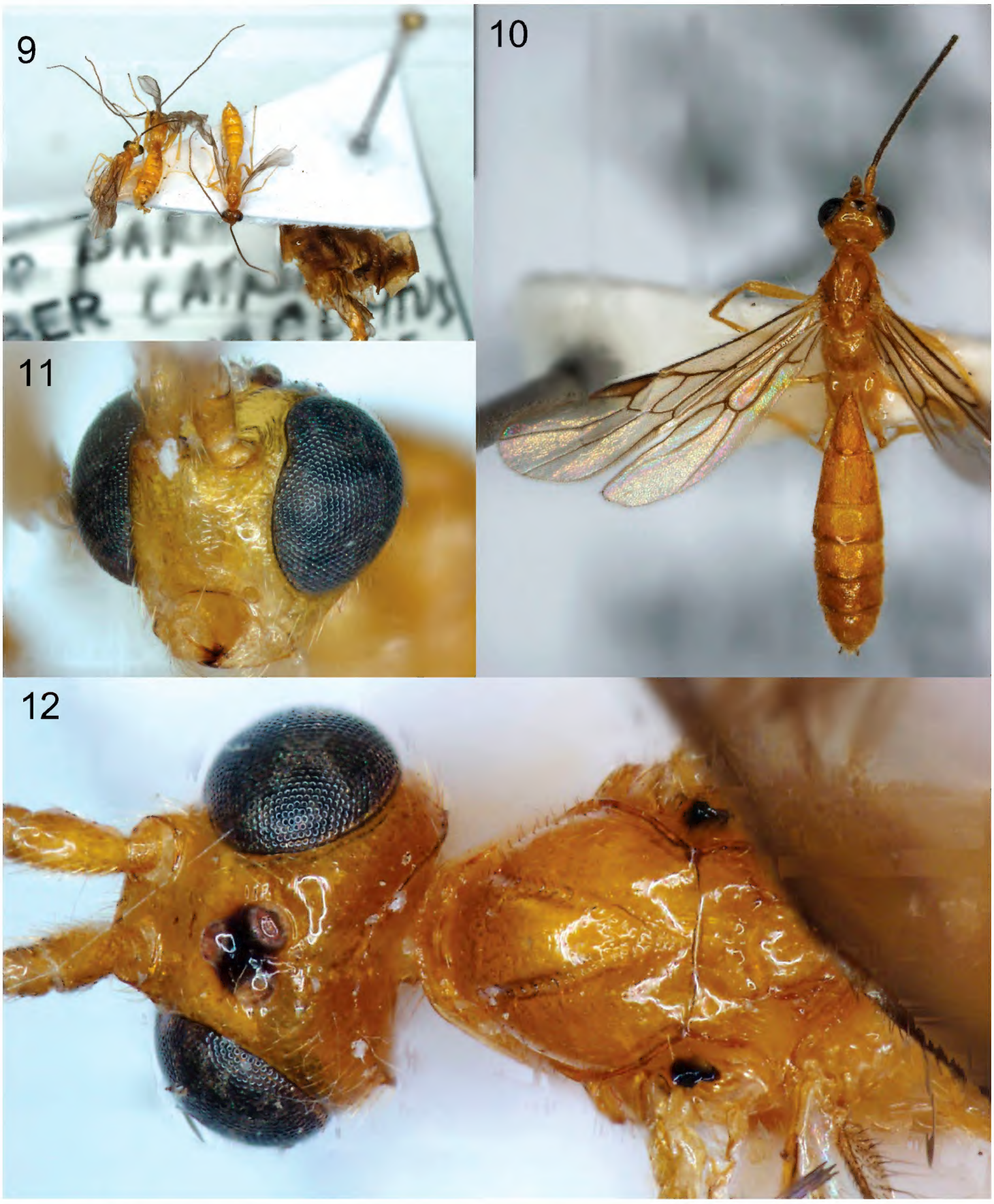
Biology. Gregarious parasitoid of *Glyphodes* near *stolalis.*

Etymology. Based on gregarious biology.

Figures 6–8. *Colastomion gregarius* sp. n. light photomicrographs. **6** Head and anterior mesosoma, dorsal view **7** propodeum **8** metasoma.

***Colastomion masalaii* Quicke, sp. n.**
urn:lsid:zoobank.org:act:0C6B94FD-975C-435A-A554-171939C4D138
http://species-id.net/wiki/Colastomion_masalaii
Figs 9–16

Material examined. Holotype female, East Sepik Province, Wamangu, 143°39.125'E, 03° 47.228'S, 100m, 30-Mar-05, ex caterpillar on *Ficus bernaysii* King (Moraceae),. (voucher USNM ENT 00503254; BOLD ASQSP055-08; Genbank JF271305) [fur-



Figures 9–12. *Colastomion masalaii* sp. n. holotype and paratypes, Cell^D® light photomicrographs. **9** Brood including holotype (furthest individual from pin on card) and two female paratypes **10** habitus, dorsal view **11** face, oblique view **12** head and mesosoma, dorsal view.

thest individual from pin on card]. Host remnants were sequenced (BOLD ASPN766-09, Genbank JF271356) and the sequence identified as *Glyphodes margaritaria*.

Paratypes. 2 additional females on same card and from same brood as holotype; see Table 1 for all data on 30 additional rearings totalling 33 paratypes. Specimens USNM ENT 00491800, USNM ENT 00491811 and USNM ENT 00648414 are deposited in the BMNH.

Table 1. Collection data, sex, host and host plant associations of paratypes of *Colastomion masalaii* sp. n.

USNM ENT voucher number	BOLD process ID	Genbank accession number	No. and sex	Province	Locality[a]	Latitude and longitude	Collection date	Host identification	Host plant
00209066	-	-	4F	Madang	Baitabag	145°47'E, 5°08'S	20-Nov-02	Crambidae	*Ficus molior* F. Meull. ex Benth. (Moraceae)
00211702	-	-	1F	East Sepik	Elem	143°55'E, 4°49'S	16-Apr-03	Crambidae	*Ficus conocephalifolia* Ridley (Moraceae)
00491773	-	-	1M	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491774	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491775	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491776	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491790	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491794	ASQSP126-08	JF271307	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491795	ASQSP125-08	JF271308	1M	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491799	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491800	ASQSP128-08	JF271306	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491801	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	30-Jul-04	*Talanga sexpunctalis* complex	— ditto —
00491807	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	no host information	— ditto —
00491808	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491809	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491810	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00491811	-	-	1F	Sandaun	Utai	141°35.153'E, 3°23.043'S	28-Jul-04	Crambidae	— ditto —
00506254	-	-	4F	Madang	Ohu	145°41'E, 5°14'S	12-Jul-04	*Glyphodes margaritaria* (Cramer)	*Ficus dammaropsis* Diels
00643279	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	*Ficus conocephalifolia* Ridley
00643281	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00643282	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —

USNM ENT voucher number	BOLD process ID	Genbank accession number	No. and sex	Province	Locality[a]	Latitude and longitude	Collection date	Host identification	Host plant
00643285	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00643293	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00643294	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00643295	ASQSP059-08	JF271309	1M	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00643298	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00643299	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00648414	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00648415	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —
00648419	-	-	1F	Madang	Wanang	145°10.910'E, 5°13.853'S	26-Apr-05	Crambidae	— ditto —

[a] Ohu is 200 m above mean sea level, other localities are 100 m above mean sea level

Figures 13–16. *Colastomion masalaii* sp. n. Cell^D® light photomicrographs. **13** Mesosoma, lateral view **14** propodeum and 1st tergite **15** fore wing **16** metasoma.

Morphology. Length of body 5.5–6.5 mm, of fore wing 48–5.0 mm and of antenna 7.0 mm.

Head. Antenna with 35–37 flagellomeres. Terminal flagellomere pointed, not or hardly acuminate. Median flagellomeres 1.8 × longer laterally than wide. 3rd segment of maxillary palp of female not swollen, approximately 7 × longer than maximally wide. 5th segment approximately 0.7 length of 6th. Base of mandible well separated from eye, closest point approximately 1.2 distance from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 3.0 × shortest distance between pit

and eye. Width of face: width of head across eyes: height of eye = 1.0 : 2.3 : 1.3. Face with distinct transverse striation laterally. Frons with distinct pattern of elongate pits forming chevrons on either side of midlongitudinal sulcus. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 1.6: 2.0. Occipital carina complete but irregular and weak mediodorsally

Mesosoma. Notauli more or less impressed along whole length, and crenulated, converging medioposteriorly and mesoscutum with some irregular rugosity at their confluence. Mesopleuron smooth and shiny. Precoxal sulcus strongly impressed, rather narrow, foveate. Propodeum with short midlongitudinal carina anteriorly that splits giving rise to a widening midlongitudinal depression with moderately well developed transverse striation. Propodeum with distinct mediolateral projections.

Fore wing. Vein 1-CU1 antefurcal. Vein 2-CU1 9 × longer than 1-CU1. Lengths of veins SR1: 3-SR: r = 5.5: 3.5: 1.0. Vein 2-SR 2.4 × 2-SR+M.

Hind wing. Vein M+CU 0.7 × length of 1-M.

Metasoma. 1st metasomal tergite 1.6–1.9 × longer than posteriorly wide. 2nd metasomal tergite 1.25 × wider than long, with well developed midbasal triangular area giving rise to weak midlongitudinal carina; irregularly longitudinally striate with approximately 15 striae lateral to midlongitudinal carina. 3rd metasomal tergite 1.9 × wider than long; longitudinally striate without distinct midlongitudinal carina. 4th - 6th tergites almost smooth.

Coloration. Body largely pale brown yellow; scapus and pedicellus yellow, flagellum largely black becoming more rufous distally; legs entirely pale brown yellow. Wing membrane hyaline, venation largely brown, pterostigma dark brown.

Etymology. Named after the local forest spirits called 'masalai' in Melanesian Pidgin.

Biology. Solitary and gregarious (3 or 4 individuals per brood) endoparasitoids of *Talanga sexpunctalis* complex and *Glyphodes margaritaria* (Cramer) (both Crambidae) feeding on *Ficus* spp (Moraceae). *T. sexpunctalis* is usually considered a widespread species but appears to be a complex of species, including several in New Guinea (Craft et al. 2010: S2). *G. margaritaria* is a widespread species (Craft et al. 2010: 5043 and S2).

Colastomion madangensis **Quicke, sp. n.**

urn:lsid:zoobank.org:act:F30DD23D-34AE-4663-AC71-0A520491E039
http://species-id.net/wiki/Colastomion_madangensis
Figures 17–22

Material examined. Holotype female, Papua New Guinea, Madang Province, Wanang, 24-May-07, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar on *Ficus variegata* Blume (Moraceae) (vouchers USNM ENT 00680132; BOLD ASQSP177-08; Genbank JX034716) [individual furthest from pin on upper card] [host *Glyphodes* near *stolalis*].

Paratypes: 5 females, 2 males, from same brood as holotype, mounted on 3 cards on same pin; 6 females, 3 males mounted on 2 cards on same pin, Madang Province, Wanang, 10-May-06, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar on *Ficus variegata* Blume, (voucher USNM ENT 00680061; BOLD ASQSP081-08; Genbank JF271301); 9 fe-

Figures 17–20. *Colastomion madangesis* sp. n. holotype, Cell^D® light photomicrographs. **17** Habitus, dorsal view **18** face, showing slender 3rd segment of maxillary palp **19** propodeum **20** head and anterior mesosoma, dorsal view.

males, 3 males, mounted on three cards on same pin, Madang Province, Wanang, 24-May-07, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar on *Ficus variegata* Blume, Moraceae, (voucher USNM ENT 00680102; BOLD ASQSP083-08; Genbank JX034721) [host *Glyphodes* near *stolalis*]; 10 individals, Madang Province, Wanang, 10-May-06, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar on *Ficus variegata* Blume, Moraceae, (voucher USNM ENT 00680111; BOLD ASQSP139-08; Genbank JX034722).

Figures 21–22. *Colastomion madangesis* sp. n. holotype, Cell^D® light photomicrographs. **21** Wings **22** metasoma.

Morphology. Length of body 4.3–5.5 mm, of fore wing 3.0–4.1 mm and of antenna 4.5–5.0 mm.

Head. Antenna with 35–39 flagellomeres. Terminal flagellomere acuminate. Median flagellomeres 2.3 × longer than wide. 3rd segment of maxillary palp of female slender, approximately 7 longer than maximally wide. 5th segment slender and approximately same length of 6th. Base of mandible well separated from eye, closest point approximately 1.1 distance from middle of anterior tentorial pit and eye. Distance be-

tween anterior tentorial pits approximately 5.2 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 2.25 : 1.36. Face laterally with well developed transverse rugosity. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 1.0 : 1.0. Occipital carina complete but distinctly weak mediodorsally

Mesosoma. Notauli more or less strongly impressed and crenulated. Mesoscutum rugulose at confluence of notauli. Mesopleuron largely smooth and shiny. Precoxal sulcus strongly impressed, weakly sinuate, strongly finely crenulated. Propodeum with short midlongitudinal carina anteriorly that splits giving rise to a widening midlongitudinal depression with moderately well developed transverse striation.

Fore wing. Vein 1-CU1 antefurcal. Vein 2-CU1 7 × longer than 1-CU1. Vein 1-M weakly curved. Lengths of veins SR1: 3-SR: r = 4.5:2.7:1.0. Vein 2-SR 2.8 × 2-SR+M.

Hind wing. Vein M+CU 0.6 × length of 1-M. Vein 2-SC+R thickened, distinctly inclivous. Vein SR weakly curved on basal half, getting closest to wing margin approximately 0.6 distance to wing tip, then running more or less parallel to wing margin.

Metasoma. 1st metasomal tergite 1.4 × longer than posteriorly wide. 2nd metasomal tergite 1.35 × wider than medially long, with well developed midbasal triangular area giving rise to complete midlongitudinal carina; irregularly longitudinally striate with approximately 8 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.9 × wider than long; longitudinally striate, without distinct midlongitudinal carina. 4th tergite distinctly irregularly longitudinally striate, 5th tergite more weakly striate and largely only on basal 0.5; 6th tergite smooth.

Coloration. Body largely brown yellow, metasoma somewhat more reddish; antennae largely cream white, darkening to blackish near tip; fore legs entirely, mid- and hind legs from apex of coxa white. Wing membrane hyaline, venation largely brown, pterostigma largely brown, paler at base.

Etymology. Named in reference to the province where specimens were reared.

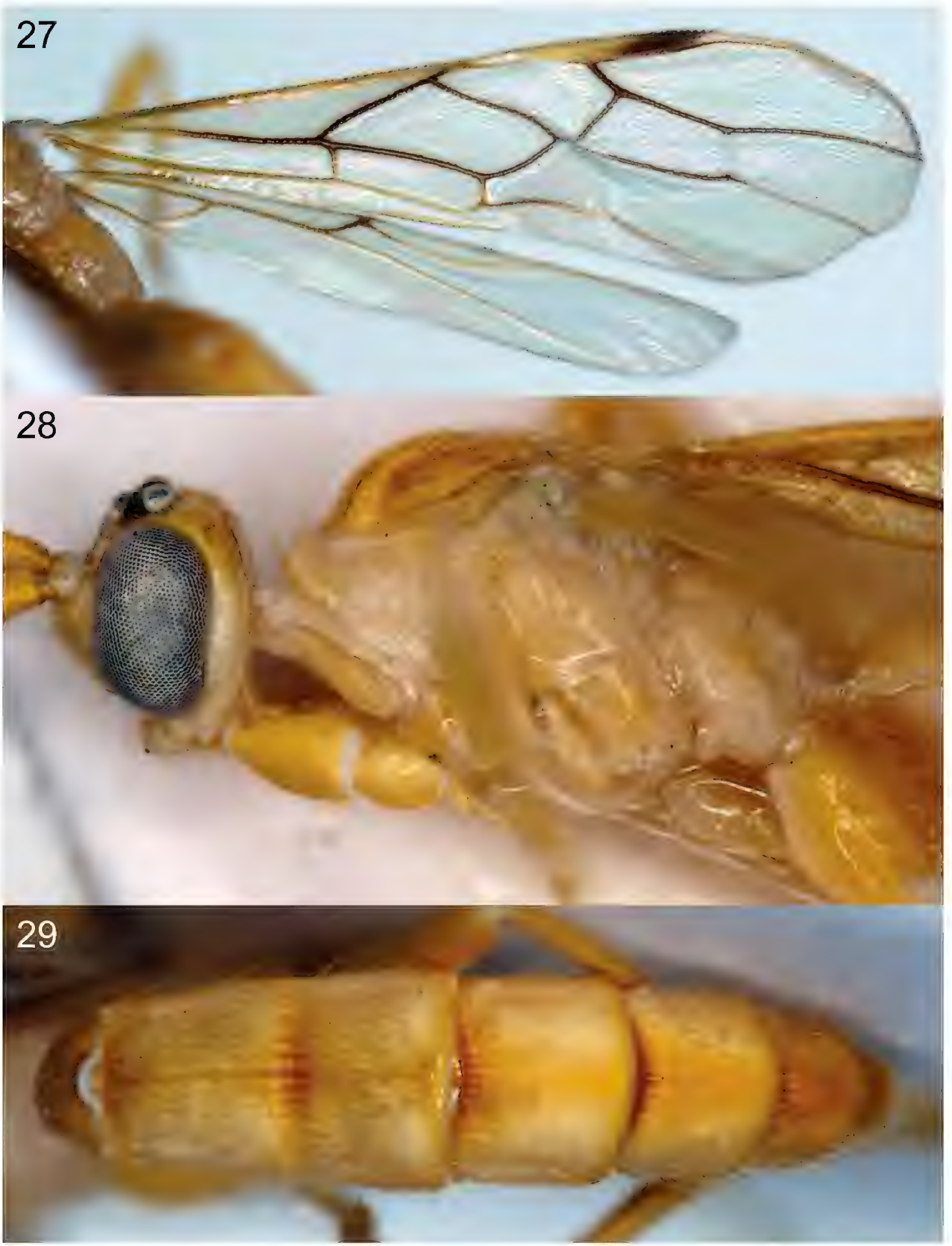
Biology. Gregarious parasitoid of *Glyphodes* near *stolalis* Guenee 1854, caterpillars: the broods reared comprised members of both sexes. *Glyphodes* near *stolalis* is a member of a species complex needing revision (Munroe 1996: 280), complicated by the type of *stolalis* being lost (Viette 1987) (Hrcek et al. 2011: supplement).

***Colastomion crambidiphagus* Quicke, sp. n.**
urn:lsid:zoobank.org:act:ACC78520-7B06-49C3-83D1-2701CC861913
http://species-id.net/wiki/Colastomion_crambidiphagus
Figs 23–29

Material examined. Holotype male, Papua New Guinea, Madang Province, Wanang, 12-Apr-07, 145°10.910'E, 5°13.853'S, 100m, WP-5E-2952, ex caterpillar on *Merremia peltata* (L.) Merr. (Convolvulaceae) (voucher USNM ENT 00680146; BOLD ASQSP086-08; Genbank JX034720).

Figures 23–26. *Colastomion crambidiphagus* sp. n. holotype, Cell^D® light photomicrographs. **23** Habitus, lateral view **24** face **25** head and anterior mesosoma, dorsal view **26** propodeum.

Paratypes: 1 female, Papua New Guinea, Madang Province, Wanang, 16-Feb-2007, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar feeding on *Merremia peltata* (L.) Merr. (Convolvulaceae) (voucher USNM ENT 00680134; BOLD ASQSP135-08; Genbank JF963127); 1 female, Papua New Guinea, Madang Province, Wanang, 20-Jun-06, 145°10.910'E, 5°13.853'S, 100m, ex caterpillar feeding on *Merremia peltata* (L.) Merr. (Convolvulaceae) (voucher USNM ENT 00680173, no sequence data).



Figures 27–29. *Colastomion crambidiphagus* sp. n. holotype, Cell^D® light photomicrographs. **27** Wings **28** head and mesosoma, lateral view **29** metasoma.

Morphology. Length of body 6.0–8.5 mm, of fore wing 5.0–6.5 mm and of antenna 8.0–8.5 mm.

Head. Antenna with 45 flagellomeres. Terminal flagellomere strongly acuminate. Median flagellomeres approximately 2.5 × longer than wide. 3rd segment of maxillary palp of female swollen, approximately 4.0 longer than maximally wide. 5th segment reduced, approximately 0.5 length of 6th. Base of mandible separated from eye by approximately same distance as from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 4.0 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 2.5 : 1.6. Face weakly transversely to obliquely striate dorsolaterally. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 2.0 : 1.2. Occipital carina narrowly obliterated medially

Mesosoma. Notauli moderately deep, narrow and crenulated, uniting shortly before posterior of mesoscutum. Mesoscutum with distinct narrow midlongitudinal groove posteriorly. Propodeum with midlongitudinal carina at least on anterior 0.5, posteriorly either complete with strong transverse rugae lateral to it, or replaced by transverse rugosity.

Fore wing. Vein 1-CU1 postfurcal. Vein 2-CU1 18–19 × longer than 1-CU1. Lengths of veins SR1: 3-SR: r = 4.5 : 2.7 : 1.0. Vein 2-SR 2.1 × 2-SR+M.

Hind wing. Vein M+CU 1.1 × length of 1-M. Vein 1-SC+R slightly thickened, almost transverse. Vein SR strongly curved on basal half, almost reaching wing margin approximately half distance to wing tip, then running more or less parallel to wing margin.

Metasoma. 1st metasomal tergite 2.0 × longer than posteriorly wide. 2nd metasomal tergite 1.1 × longer than maximally wide, with well developed midbasal triangular area giving rise to complete midlongitudinal carina; irregularly longitudinally striate with approximately 6 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.1 × longer than maximally wide; longitudinally striate. 4th and 5th tergites longitudinally striate. 6th tergite smooth.

Coloration. Body.

Etymology. Named because of its parasitism of Crambidae.

Biology. Solitary endoparasitoids of Crambidae feeding on *Merremia peltata* (L.) Merr. (Convolvulaceae). The holotype was reared from *Hydriris guadealis* Rothschild. Paratype USNM ENT 00680134 was reared from *Tabidia insanalis* Snellen, and paratype USNM ENT 00680173 was reared from.a further unidentified crambid.

***Colastomion parotiphagus* Quicke, sp. n.**
urn:lsid:zoobank.org:act:BE5DD9B9-5DB2-4C52-A95C-ED2FE0E76FD0
http://species-id.net/wiki/Colastomion_parotiphagus
Figs 30–32

Material examined. Holotype male, Papua New Guinea, Madang Province, Wanang, 30-May-07, 145°10.910'E, 5°13.853'S, 100m, WS-2D-0932, ex caterpillar on *Sarcocephalus coadunatus* (Sm.) Druce (Rubiaceae), CATX043 (voucher USNM ENT

Figures 30–32. *Colastomion parotiphagus* sp. n. holotype, Cell^D® light photomicrographs. **30** Habitus, dorsal view **31** head and anterior mesosoma, dorsal view **32** head and mesosoma, lateral view.

00680014; BOLD ASQSP026-08; Genbank JX034709) [Host – *Parotis tricoloralis* (Pagenstecher)].

For details of 34 paratypes see Table 2.

For details of 34 paratypes see Table 2. Specimens USNM ENT 00680067, USNM ENT 00680154 and USNM ENT 00690187 are deposited in the BMNH.

Morphology. Length of body 6.2–9.5 mm, of fore wing 5.8–7.5 mm and of antenna 7.5–9.5 mm.

Head. Antenna with 50 flagellomeres. Terminal flagellomere acuminate. Median flagellomeres 2 × longer than wide. 3rd segment of maxillary palp of female distinctly swollen, approximately 3.5 × longer than maximally wide. 5th segment reduced and approximately half length of 6th. Base of mandible very close to eye, closest point approximately 0.2 distance from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 5 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 2.5 : 1.6. Face transversely striate except for smooth triangular area above clypeus extending nearly to antennal sockets. Frons largely smooth but with well developed ridge running parallel to eye margin and reaching stemmaticum. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.5: 2.5:1.0. Occipital carina complete, well developed dorsally.

Mesosoma. Notauli deep, complete, finely punctate anteriorly becoming obliquely crenulated posteriorly, uniting to form groove before posterior margin of mesoscutum. Mesoscutum with an elongate groove between notauli anterior to the point of their fusion. Propodeum with complete midlongitudinal carina. Mesopleuron largely smooth. Precoxal sulcus narrow and deep on posterior half of mesopleuron, finely crenulated. Propodeum with complete midlongitudinal carina.

Fore wing. Vein 1-CU1 postfurcal. Vein 2-CU1 6.4 × longer than 1-CU1. Lengths of veins SR1: 3-SR: r = 4.0: 1.6 :1.0. Vein 2-SR 2.0 × 2-SR+M.

Hind wing. Vein M+CU 1.75 × length of 1-M. Vein 2-SC+R weakly thickened, distinctly reclivous. Vein SR strongly curved on basal half, almost reaching wing margin approximately half distance to wing tip, then distinctly diverging again towards wing tip.

Metasoma. 1st metasomal tergite 2.2 × longer than posteriorly wide. 2nd metasomal tergite as long as maximally wide, with well developed midbasal triangular area giving rise to complete midlongitudinal carina; irregularly longitudinally striate with approximately 8 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.4 × wider than long; longitudinally striate and with midlongitudinal carina more or less differentiated. 4th and 5th tergites longitudinally striate. 6th tergite smooth (faintly aciculate).

Coloration. Head and body ochreous yellow, stemmaticum black, hypopygium usually brown. Scapus and pedicellus bright yellow, contrasting with flagellum which is usually largely black but with variable paler brown-yellow to yellow zone from approximately middle to near the apex. Wing membrane yellowish on basal half, pale grey distally; pterostigma bicolorous, dark brown distally but with large yellow zone basally and posterobasally.

Etymology. Named after the known host genus.

Biology. Solitary larval endoparasitoids of *Parotis tricoloralis* (Pagenstecher) (Crambidae), *Parotis hilaralis* (Walker) (Crambidae) and *Haritalodes adjunctalis* Leraut (Crambidae).

Table 2. Collection data, sex, host and host plant associations of paratypes of *Colastomion parotiphagus* sp. n.

USNM ENT voucher number	BOLD process ID	Genbank accession number	Sex	Province	Locality[a]	Latitude and longitude	Collection date	Host identification	Host plant
00206476	-	-	F	Madang	Baitabag	145°47'E, 5°08'S	04-Jun-02	*Haritalodes adjunctalis* Leraut	*Hibiscus tiliaceus* L. (Malvaceae)
00680001	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	*Sarcocephalus coadunatus* (Sm.) Druce (Rubiaceae)
00680023	-	-	F	Madang	Wanang	145°10.910'E, 5°13.853'S	23-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680026	ASQSP094-08	JX034711	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680031	ASQSP090-08	JX034723	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680035	-	-	F	Madang	Wanang	145°10.910'E, 5°13.853'S	24-Feb-06	*Parotis tricoloralis* (Pag.)	— ditto —
00680040	ASQSP137-08	JX034713	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680056	ASQSP018-08	JF271317	M	Madang	Wanang	145°10.910'E, 5°13.853'S	23-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680057	-	-	F	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680060	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680067	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	23-Feb-06	*Parotis tricoloralis* (Pag.)	— ditto —
00680075	-	-	F	Madang	Wanang	145°10.910'E, 5°13.853'S	12-May-06	*Parotis tricoloralis* (Pag.)	— ditto —
00680082	ASQSP091-0	JX034710	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680085	-	-	?	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680086	ASQSP089-08	JX034714	F	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680088	ASQSP092-08	JX034718	F	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680093	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680097	ASQSP020-08	JF271315	F	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680103	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680106	-	-		Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680108	ASQSP136-08	JX034717	M	Madang	Wanang	145°10.910'E, 5°13.853'S	13-May-06	most likely *Parotis*	— ditto —
00680117	ASQSP082-08	JF963129	F	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680124	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	12-May-06	*Parotis tricoloralis* (Pag.)	— ditto —

USNM ENT voucher number	BOLD process ID	Genbank accession number	Sex	Province	Locality[a]	Latitude and longitude	Collection date	Host identification	Host plant
00680128	ASQSP025-08	JF271314	?	Madang	Wanang	145°10.910'E, 5°13.853'S	23-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680130	ASQSP027-08	JX034715	F	Madang	Wanang	145°10.910'E, 5°13.853'S	21-Jun-07	no host information	*Actinodaphne nitida* Teschn. (Lauraceae)
00680131	ASQSP138-08	JF271318	F	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	*Sarcocephalus coadunatus* (Sm.) Druce (Rubiaceae)
00680142	-	-	?	Madang	Wanang	145°10.910'E, 5°13.853'S	31-May-07	No host information	*Trema orientalis* (L.) Blume (Ulmaceae)
00680143	ASQSP019-08	JF271316	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	*Sarcocephalus coadunatus* (Sm.) Druce (Rubiaceae)
00680145	ASQSP032-08	JX034708	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680148	-	-	M	Madang	Wanang	145°10.910'E, 5°13.853'S	30-May-07	*Parotis tricoloralis* (Pag.)	— ditto —
00680154	ASQSP093-08	JX034712	F	Madang	Wanang	145°10.910'E, 5°13.853'S	12-May-06	*Parotis tricoloralis* (Pag.)	— ditto —
00680176	-	-	?	Madang	Wanang	145°10.910'E, 5°13.853'S	7-Mar-07	most likely *Parotis*	— ditto —
00680187	ASQSP130-08	JX034719	M	Madang	Wanang	145°10.910'E, 5°13.853'S	18-Apr-06	*Parotis tricoloralis* (Pag.)	— ditto —
00680194	ASQSP181-08	JF271319	F	Madang	Wanang	145°10.910'E, 5°13.853'S	13-May-06	*Parotis hilaralis* (Walker) (host sequence: ASPN768-09; Genbank JF271498)	— ditto —

[a] Both localities are 100m above mean sea level

***Colastomion wanang* Quicke, sp. n.**
urn:lsid:zoobank.org:act:EDAACAC2-0645-45D7-860F-2C959EFE4D0F
http://species-id.net/wiki/Colastomion_wanang
Figs 33–41

Material examined. Holotype female, Papua New Guinea, Madang Province, Wanang, 29-Apr-05, 145°10.910'E, 5°13.853'S, 100m, SSW, ex caterpillar on *Syzigium longipes* (Warb.) Merrill & Perry (Myrtaceae), Mark (voucher USNM ENT 00643283; BOLD ASQSP063-08; Genbank JF271302). [see *Notes* on possible conspecifics excluded from type series].

Morphology. Length of body 12 mm, of fore wing 8.8 mm.

Head. Antenna with 56–57 flagellomeres. Terminal flagellomere acuminate. Median flagellomeres approximately 2 × longer than wide. 3rd segment of maxillary palp of female weakly swollen, approximately 6 longer than maximally wide. 5th segment approximately 0.8 length of 6th. Base of mandible very close to eye, closest point approximately same as distance from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 10 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 3.3 : 2.0. Face with coarse transverse striae ventrolaterally, becoming finer and reaching near to midline dorsally. Frons with rather well developed ridge paralleling margin of eye; generally with weak sublongitudinal sculpture Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 3.5: 1.7. Occiput with deep crescent-shaped depressions behind posterior ocelli; with only weak midlongitudinal groove. Occipital carina complete and strongly lamelliform.

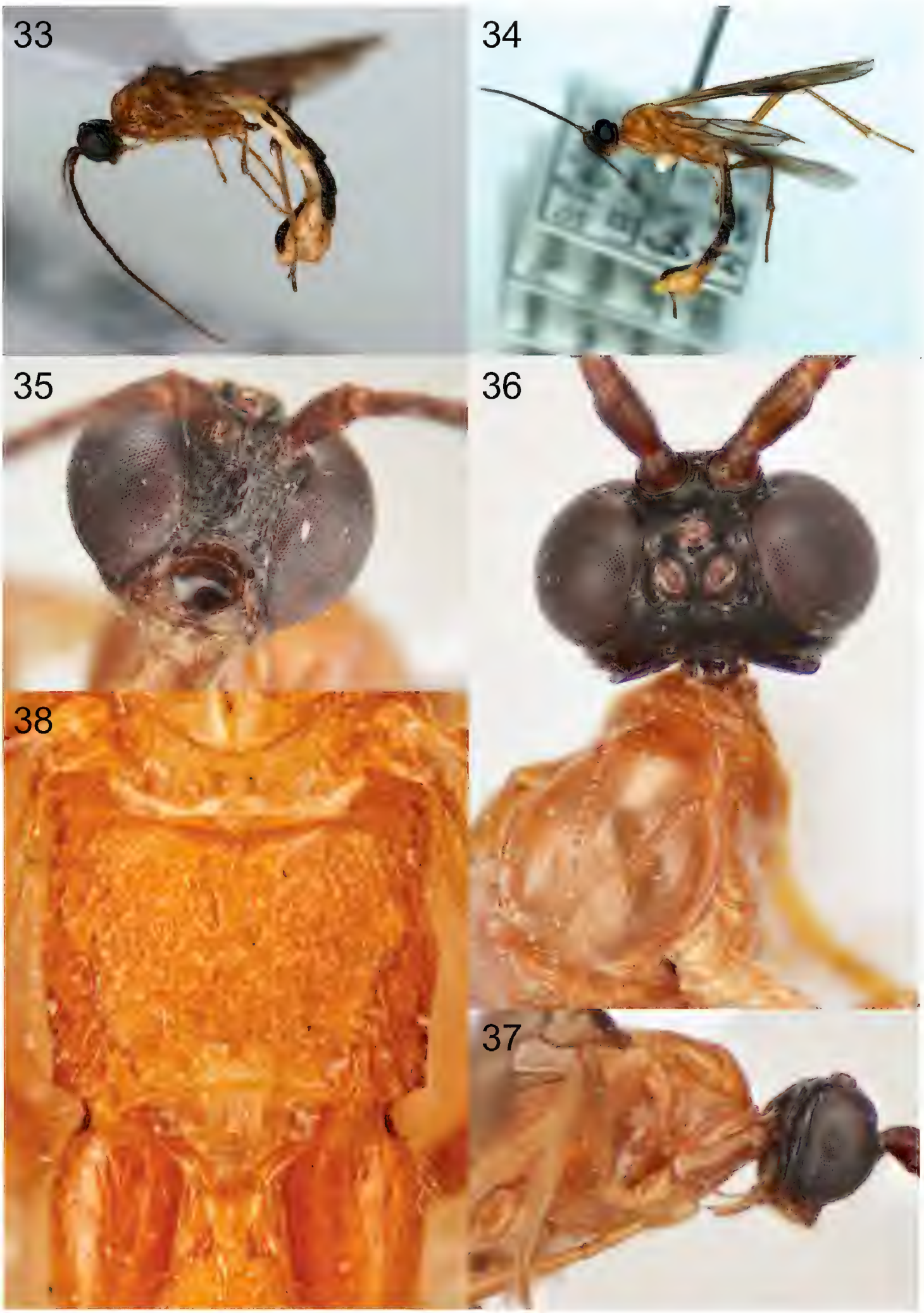
Mesosoma. Notauli weakly impressed anteriorly, dorsally crenulated to foveate as impressions get weaker. Mesoscutum smooth where notauli converge. Mesopleuron smooth and shiny. Precoxal sulcus strongly impressed, rather narrow, smooth. Propodeum with complete midlongitudinal carina.

Fore wing. Vein 1-CU1 postfurcal. Vein 2-CU1 5.8 × longer than 1-CU1. Vein 1-M weakly curved near base. Lengths of veins SR1: 3-SR: r = 3.5:2.7:1.0. Vein 2-SR 4 × 2-SR+M.

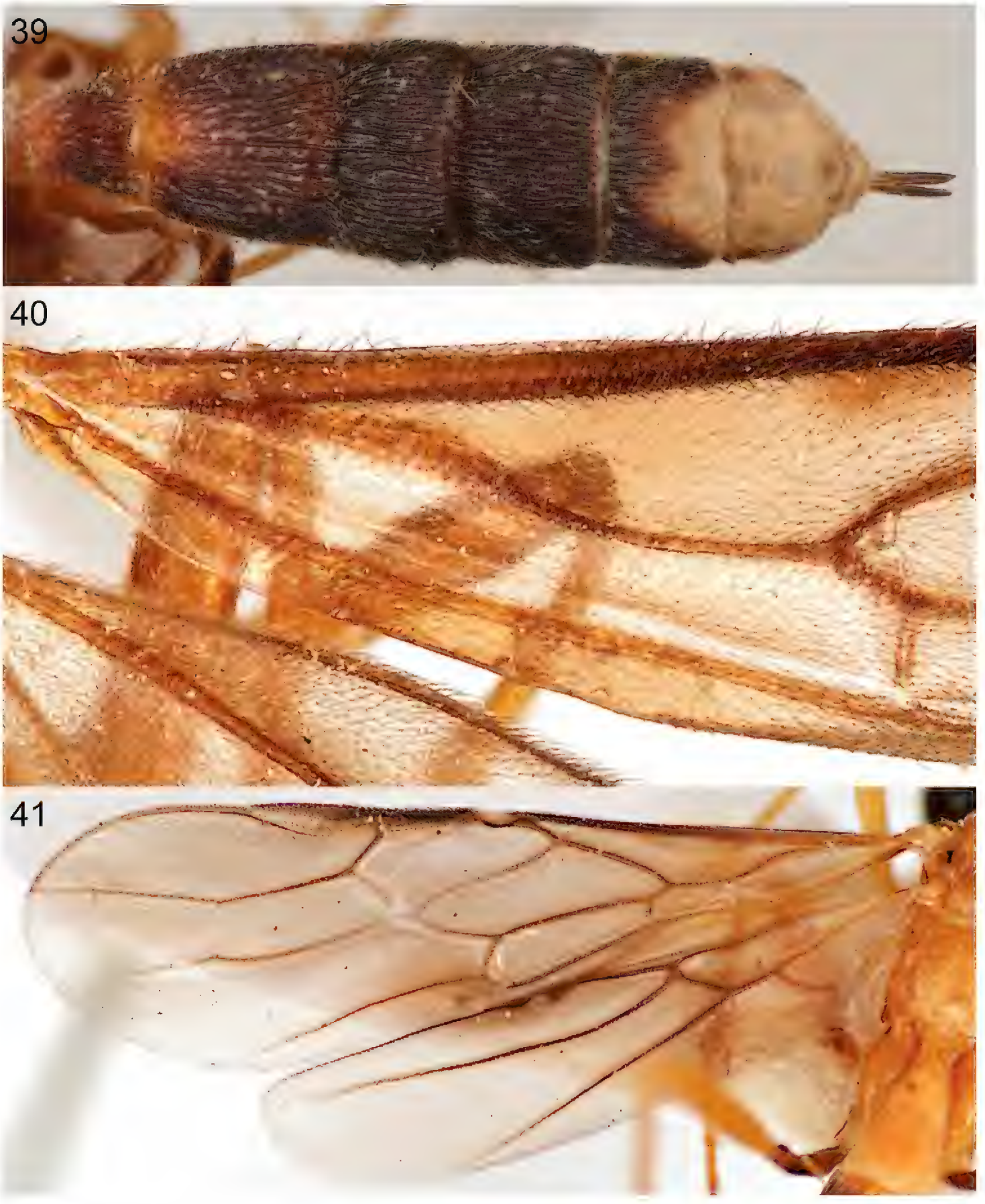
Hind wing. Vein M+CU 2.5 × length of 1-M. Vein 2-SC+R very thick, short transverse. Vein SR gently curving basally and gradually getting closer to anterior margin towards wing tip.

Metasoma. 1st metasomal tergite 2.0 × longer than posteriorly wide. 2nd metasomal tergite 1.1 × wider than long, with well developed midbasal triangular area giving rise to complete midlongitudinal carina; irregularly longitudinally striate with approximately 7 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.3 × longer than maximally wide; longitudinally striate. 4th and 5th tergites entirely coarsely longitudinally striate. 6th tergite faintly aciculate.

Coloration. Head, hind trochanter and trochantellus and metasomal tergites 1–4 (largely) black, tergite 5 black basally and laterally, hind tibia dark brown to black,



Figures 33–38. *Colastomion wanang* sp. n. **33, 34** Holotype female and putatively conspecific individual (USNM ENT 00206919) habitus respectively. **35** face of holotype **36** head and anterior mesosoma of holotype, dorsal view **37** head and anterior mesosoma of holotype, lateral view **38** propodeum of putatively conspecific individual (USNM ENT 00452009).



Figures 39–41. *Colastomion wanang* sp. n. **39** Metasomal tergites of holotype **40** base of fore wing of holotype showing distinctive thickening and sudden curving of vein M+CU **41** wings of putatively conspecific individual (USNM ENT 00452009).

mesosoma and rest of legs orange red, metasomal tergites 5 medioposteriorly and tergite 6 largely cream white. Wings largely pale brown with dark brown venation, pterostigma entirely dark brown.

Etymology. Named after collection locality as a noun in apposition.

Biology. Host unknown for holotype.

Notes. Four specimens with host data from a different locality and host tree but lacking barcoding data probably belong to this species but are excluded for the above reason from the type series. We can find no convincing morphological difference between them and the holotype of *C. wanang* sp. n. though they do have the 1st metasomal tergite largely orange. Their collection data are:

Papua New Guinea, Madang Province, Baitabag, 23-Jul-02, 145°47'E, 5°08'S, 100m, Ulai ex caterpillar on *Leea indica* Merrill (Vitaceae) (voucher USNM ENT 00206919); 1 male, Madang, Baitabag, 23-Jan-04, 145°47'E, 5°08'S, 100m, ex caterpillar on *Leea indica* Merrill (Vitaceae) (voucher USNM ENT 00452009); 1 male, Madang Province, Mis, 1-Aug-02, 145°47'E, 5°11'S, 50m, ex caterpillar on *Leea indica* Merrill, Vitaceae, David (voucher USNM ENT 00206716); 1 female [metasoma missing but palps not swollen], Madang Province, Mis, 23-Jul-02, 145°47'E, 5°11'S, 50m (voucher USNM ENT 00206736). These four specimens were solitary larval endoparasitoids of one or both of two similar species which are superficially similar to "*Syllepte*" *crotonalis* Walker (CRAM078, Genbank GU695707 and CRAM092, Genbank GU695702). The genus *Syllepte* has accumulated many unrelated brown moths, and needs revision, so the correct generic name is also unclear.

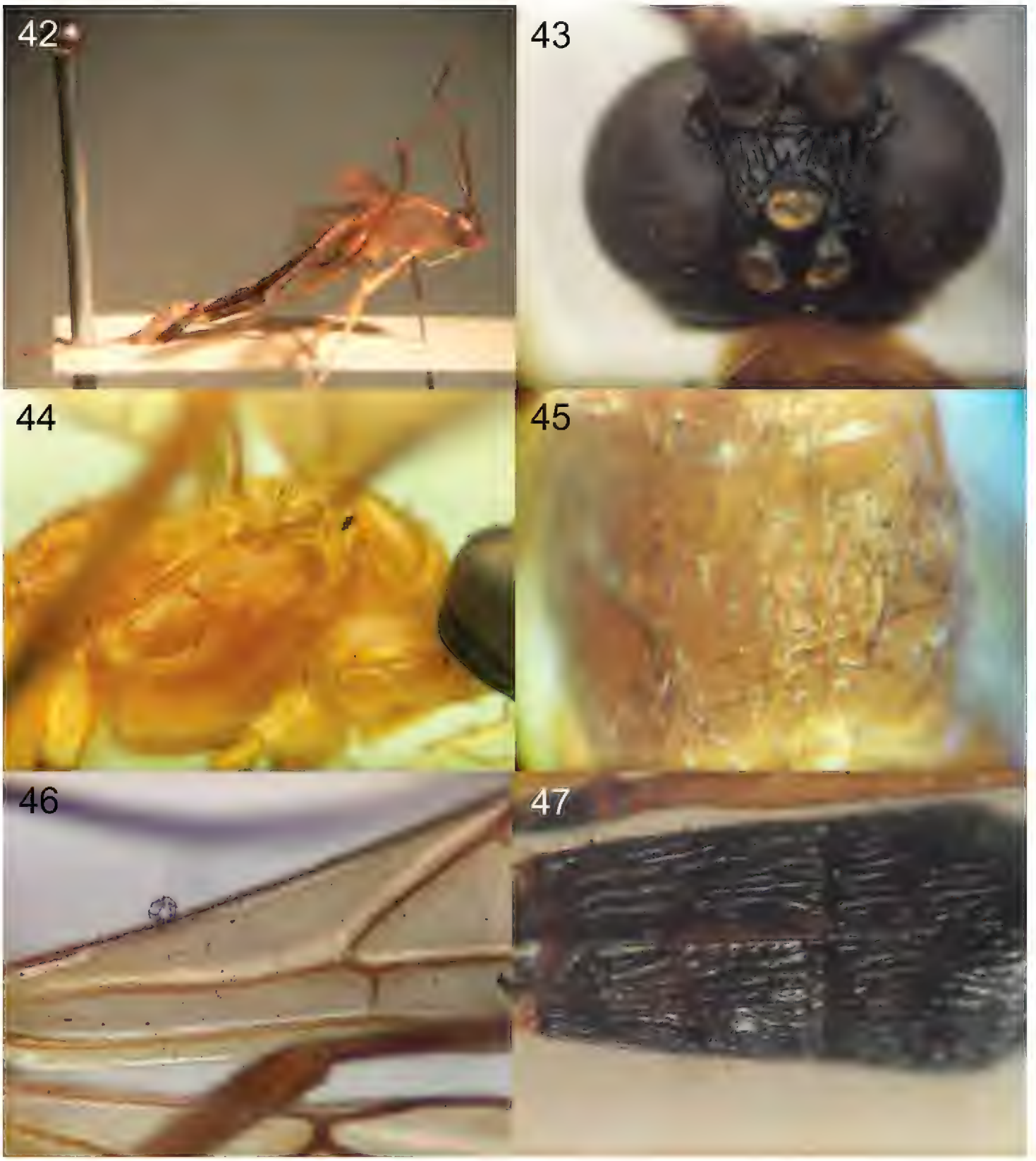
***Colastomion cheesmanae* Quicke, sp. n.**
urn:lsid:zoobank.org:act:757380FD-963E-4583-A8AC-44FD96ABCB19
http://species-id.net/wiki/Colastomion_cheesmanae
Figs 42–47

Material examined. Holotype female, Papua New Guinea, Oro Province, Kokoda, iv.1933, 1200ft [= 365 m], L. E. Cheesman (NHM).

Morphology. Length of body 11 mm, of fore wing 8.5 mm and of antenna 9.2 mm.

Head. Antenna with 55 flagellomeres. Terminal flagellomere acuminate. Median flagellomeres approximately 2 × longer than wide. 3rd segment of maxillary palp of female rather slender, approximately 5 longer than maximally wide. 5th segment 1.5 × length of 6th. Base of mandible well very close to eye, closest point approximately same distance as from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 6 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 3.1 : 2.2. Face rather shiny, with quite strong diagonal striation laterally above level of clypeus. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 2.5 : 1.4. Occipital carina complete mediodorsally

Mesosoma. Notauli narrow, weakly impressed, finely crenulated anteriorly becoming more foveate posteriorly. Mesoscutum smooth and broadly depressed at confluence of notauli. Mesopleuron largely smooth and shiny. Precoxal sulcus deeply, narrow, weakly crenulate. Propodeum with complete midlongitudinal carina and largely rugose with only narrow smooth and punctate area submedially anteriorly. Propodeum evenly rounded, without mediolateral projections.



Figures 42–47. *Colastomion cheesmanae* sp. n. light photomicrographs of holotype **42** Habitus, lateral view **43** head dorsal view **44** mesosoma, lateral view **45** propodeum **46** basal half of fore wing **47** metasomal tergites **2** and 3.

Fore wing. Vein M+CU distinctly though weakly curved on distal half, but not thickened medially. Vein 1-CU1 postfurcal. Vein 2-CU1 8.5 × longer than 1-CU1. Vein 1-M moderately strongly curved posteriorly. Vein 1-SR+M strongly bisinuate. Lengths of veins SR1: 3-SR: r = 5.0: 4.3: 1.0. Vein 2-SR 3.5 × 2-SR+M.

Hind wing. Vein M+CU 1.75 × length of 1-M. Vein 2-SC+R strongly thickened, vertical. Vein SR gently curving basally and gradually getting closer to anterior margin towards wing tip.

Metasoma. 1st metasomal tergite 2.1 × longer than posteriorly wide. 2nd metasomal tergite 1.1 × wider than long, with wide midbasal triangular area giving rise to weak midlongitudinal carina; rather weakly irregularly longitudinally striate with approximately 9 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.2 × wider than long; longitudinally striate. 4th and basal 0.6 of 5th tergites coarsely longitudinally striate, posterior of tergite 5 and all of tergite 6 smooth.

Coloration. Head, hind trochanter and trochantellus and metasomal tergite 1 posteriorly, 2–4 entirely, anterior half of tergite 5, and extreme base of tergite 6 black, hind tibia dark brown, mesosoma and rest of legs orange red, metasomal tergites 5 posteriorly and 6 largely cream-white. Antenna largely black with a distinct brown-yellow zone occupying flagellomeres 22–34. Wing membrane largely pale brown, venation largely (except more basal veins, dark brown; pterostigma dark brown.

Biology. Unknown.

Etymology. Named in honour of Miss L. E. Cheesman who collected much interesting material in New Guinea in expeditions in the 1930s (see Kimmins 1962).

Notes. Very similar to *C. wanang* sp. n. except lacks the thickened and strongly curved fore wing vein M+CU.

***Colastomion pukpuk* Quicke, sp. n.**
urn:lsid:zoobank.org:act:28EBB931-2A14-4544-AB0E-6A88C757CD21
http://species-id.net/wiki/Colastomion_pukpuk
Figs 48–51, 55

Material examined. Holotype female, Papua New Guinea, East Sepik Province, Wamangu, 11-Mar-05, 143°39.125'E, 03°47.228'S, 100m, PSS, ex caterpillar on *Psychotria micrococca* (Laut. & Schum.) Val. (Rubiaceae) (voucher USNM ENT 00505491; BOLD ASQSP060-08; Genbank JF271303)

Morphology. Length of body 10.0 mm, of fore wing 8.5–9.5 mm and of antenna 9.5–11.2 mm.

Head. Antenna with 56 flagellomeres. Terminal flagellomere strongly acuminate. Median flagellomeres 2 × longer laterally than wide. 3rd segment of maxillary palp of female moderately swollen, approximately 4 longer than maximally wide. 5th segment approximately 0.9 length of 6th. Base of mandible close to eye, closest point approximately 0.75 distance from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 6 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 3.1 : 2.0. Face with a smooth triangular area above clypeus bordered by well developed transverse striation that more or less meets medially at level of antennal sockets. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0: 2.0: 1.2. Occipital carina complete, rather wavy when viewed laterally.

Mesosoma. Notauli weakly impressed anteriorly, dorsally represented by converging lines of discrete pits. Mesoscutum smooth where notauli converge. . Mesopleuron

Figures 48–51. *Colastomion pukpuk* sp. n. holotype, Cell^D® light photomicrographs. **48** Face **49** propodeum showing largely smooth anterior **50** wings **51** metasomal tergites 2–6.

almost entirely smooth ad shiny, precoxal sulcus weakly impressed, unsculptured. Propodeum with complete strong midlongitudinal carina.

Fore wing. Vein 1-CU1 postfurcal. Vein 2-CU1 9.0 × longer than 1-CU1. Lengths of veins SR1: 3-SR: r = 4.8 : 3.5 : 1.0. Vein 2-SR 2.0 × 2-SR+M.

Hind wing. Vein M+CU 1.7 × length of 1-M. Vein SR gently curving basally and gradually getting closer to anterior margin towards wing tip.

Metasoma. 1st metasomal tergite 2.1 × longer than posteriorly wide. 2nd metasomal tergite 1.1 × longer than maximally wide, with well developed midbasal triangular area giving rise to complete midlongitudinal carina; irregularly longitudinally striate with approximately 11 striate lateral to midlongitudinal carina. 3rd metasomal tergite 1.2 × wider than long; longitudinally striate. 4th tergite largely longitudinally striate. 5th tergite longitudinally striate medially becoming smooth laterally with punctures. 6th tergite entirely smooth and punctate.

Coloration. Head, and tergites 2–4 entirely, anterior half of tergite 5, and extreme base of tergite 6 black, hind tibia dark brown, hind trochanter and trochantellus dark brown, mesosoma, 1st tergite and rest of legs orange red, metasomal tergites 4 and 5 posteriorly cream-white, tergites 6 and 7 largely cream-white. Antenna largely black with paler brown zone approximately occupying flagellomeres 22–39. Wing membrane largely pale brown, venation largely (except more basal veins, dark brown; pterostigma dark brown.

Etymology. Pukpuk in Melanesian Pidgin means crocodile, a favourite of the indigenous people living around Sepik river.

Biology. Unknown.

***Colastomion maclayi* Quicke, sp. n.**

urn:lsid:zoobank.org:act:DC1DB59F-2C17-45B6-9254-6DBD0A890EE8

http://species-id.net/wiki/Colastomion_maclayi

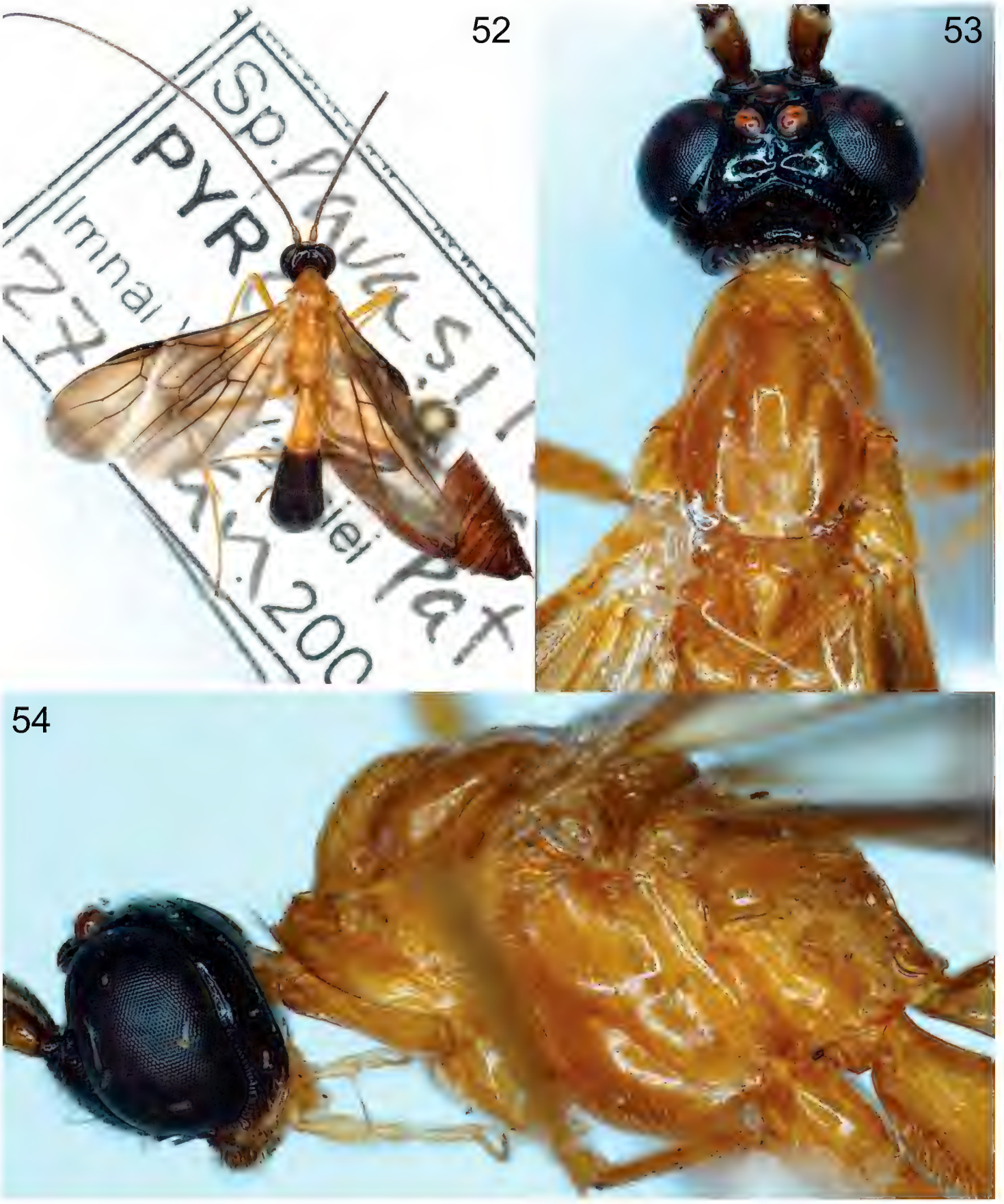
Figs 52–54, 56

Material examined. Holotype female, Papua New Guinea, East Sepik Province, Yapsiei, 27-Jan-04, 141°05.839'E, 4°37.695'S, 100m, (voucher USNM ENT 00454207; BOLD ASQSP061-08; Genbank JF271312) [mounted on same pin is a pupal case, presumably of the host species, though not the host of this individual]

Paratypes. 1 male, East Sepik Province, Yapsiei, 27-Feb-04, 141°05.839'E, 4°37.695'S, 100m (voucher USNM ENT 00454275; BOLD ASQSP064-08; Genbank JF271310); 1 male, East Sepik Province, Yapsiei, 18-Feb-04, 141°05.839'E, 4°37.695'S, 100m (voucher USNM ENT 00454148; BOLD ASQSP062-08; Genbank JF271311)

Morphology. Length of body 11 mm, of fore wing 8.7 mm and of antenna 11 mm.

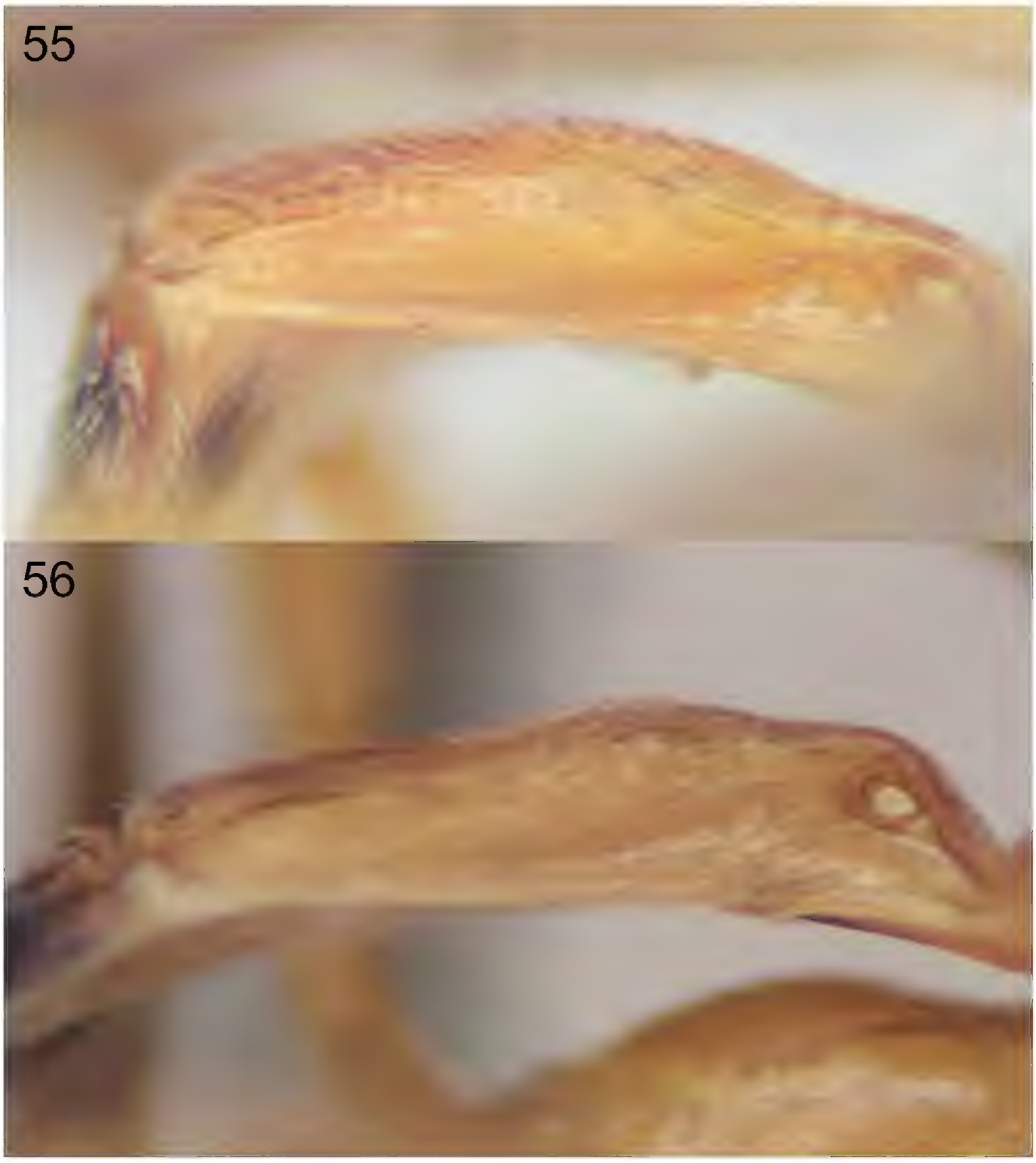
Head. Antenna with 57 flagellomeres. Terminal flagellomere distinctly acuminate. Median flagellomeres 1.8 × longer laterally than wide. 3rd segment of maxillary palp of female very weakly swollen medially swollen, approximately ?7 × longer than maximally wide. 5th segment approximately 0.65 length of 6th. Base of mandible very close to eye, closest point approximately 0.8 distance from middle of anterior tentorial pit and eye. Distance between anterior tentorial pits approximately 5.0 × shortest distance between pit and eye. Width of face: width of head across eyes: height of eye = 1.0 : 2.7



Figures 52–54. *Colastomion maclayi* sp. n. holotype, Cell^D® light photomicrographs. **52** Habitus, dorsal view **53** head and anterior mesosoma, dorsal view **54** head and mesosoma, lateral view.

: 1.9. Face largely finely transversely striate. Shortest distance between posterior ocelli: transverse diameter of posterior ocellus: shortest distance between posterior ocellus and eye = 1.0 : 3.0 : 1.1. Occipital carina well developed, complete mediodorsally.

Mesosoma. Notauli weakly impressed anteriorly, dorsally represented by converging lines of discrete pits. Mesoscutum smooth where notauli converge. Propodeum with complete midlongitudinal carina.



Figures 55–56. Lateral views of 1st metasomal tergite. **55** *Colastomion pukpuk* sp. n. **56** *Colastomion maclayi* sp. n.

Fore wing. Vein 1-CU1 postfurcal. Vein 2-CU1 8.5 × longer than 1-CU1. Lengths of veins SR1: 3-SR: r = 4.6: 3.2:1.0. Vein 2-SR 2.4 × 2-SR+M.

Hind wing. Vein M+CU 2.0 × length of 1-M. Hind wing vein 2-SC+R very thickened, almost quadrate. Vein SR gently curving basally and gradually getting closer to anterior margin towards wing tip.

Metasoma. 1st metasomal tergite 2 × longer than posteriorly wide. 2nd metasomal tergite 1.1 × longer than maximally wide, with well developed midbasal triangular area giving rise to complete midlongitudinal carina; irregularly longitudinally striate with approximately 12 striae lateral to midlongitudinal carina. 3rd metasomal tergite

1.4 × wider than long; longitudinally striate, with midlongitudinal carina distinct on anterior 0.5. 4th and 5th tergites finely longitudinally striate medially becoming weakly punctate-striate laterally

Coloration. Head, and tergites 2–4 entirely, and anterior half of tergite 5 black, hind tibia dark brown, mesosoma, 1st tergite and legs orange red, metasomal tergite 5 posteriorly cream-white, tergites 6 and 7 largely cream-white. Antenna largely black with paler brown zone approximately occupying flagellomeres 27–42. Wing membrane largely pale brown, venation largely (except more basal veins, dark brown; pterostigma dark brown.

Biology. Solitary endoparasitoid of *Meekiaria* (Crambidae) caterpillars on *Psychotria* sp. (Rubiaceae). *Meekiaria* have distinctive male genitalia with numerous closely related species in PNG (Munroe 1974, Craft et al. 2010: S2).

Etymology. Named after Nicholai Miklucho-Maklaj, a Russian explorer of New Guinea who lived around the Madang area for some time.

Discussion

The species described here comprise three groups based both on morphology and DNA (Fig. 1). *Colastomion gregarious* sp. n., *C. madangensis* sp. n. and *C. masalaii* sp. n. are all small, at least facultatively gregarious species with an antefurcal fore wing vein cu-a (Fig. 15) and an inverted 'V'-shaped carina on the propodeum (Fig. 7); *C. crambidiphagus* sp. n. and *C. parotiphagus* sp. n. are medium-sized, predominantly yellow species; *C. cheesmanae* sp. n., *C. maclayi* sp. n., *C. pukpuk* sp. n. and *C. wanang* sp. n. are all large, black headed species with largely black metasomas with whitish tips. The amount of morphological variation observed between these three groups of species is considerable, and might in the past have been deemed sufficient by some taxonomists to warrant division into different genera or subgenera, and the relatively long internal branches on the molecular phylogeny support their high level of differentiation. Addition molecular studies on the whole subfamily will be needed to determine whether, despite the vertical hind wing vein 2-SC+R, these taxa form a natural group to the exclusion of other members of the complex.

As with many rogadine wasps, *Colastomion* had no published host records prior to the current caterpillar rearing campaign in Papua New Guinea, despite it being widely distributed and occurring also in tropical Africa and S. E. Asia. In common with the closely related genus *Macrostomion* Baker, several of the new species described here are gregarious. This biology is unusual among the Rogadinae. A few species of the cosmopolitan genus *Aleiodes* Wesmael are gregarious (specifically *A. pallescens* on various Notodontidae, *A. stigmator* (Say) on Noctuidae, and *A. leptocarina* Fortier on an unidentified hairy host caterpillar). Another aspect of the gregariousness exhibited by some *Colastomion* is that the brood size is rather small, and at least one of the new species, *C. masalaii* sp. n., is facultatively gregarious. Thus they may make interesting study organisms for investigating the evolutionary transition

from solitary to gregarious life histories (Mayhew and van Alphen 1999, Mayhew and Glaizot 2001, Guinee et al. 2005).

It is interesting that all the reared *Colastomion* species are parasitoids of Crambidae, though these collectively feeding on a wide range of host plant families. Few tropical genera of Rogadinae have multiple host records, but of those that do, several appear to be relatively restricted in the range of host families attacked suggesting at least some degree of co-evolutionary tuning between host defence mechanisms and the parasitoid's ability to overcome them. However, before this can be investigated much further, a far larger body of host-parasitoid association data will be required.

Acknowledgements

We thank the New Guinea Binatang Research Center parataxonomists, village assistants and Lauren Helgen for technical assistance and George Weiblen for plant identification. This paper stems from a rearing campaign led by Vojtech Novotny, George Weiblen, SEM, and Yves Basset and supported by the US National Science Foundation (DEB 0841885, 0816749, 0515678), Grant Agency of the Czech Republic (206/08/H044, 206/09/0115 and P505/10/0673), Czech Ministry of Education (LC06073, ME9082, and MSM6007665801) and project CZ.1.07/2.3.00/20.0064 co-financed by the European Social Fund and the state budget of the Czech Republic. Laboratory reagents and Barcode of Life Datasystem (BOLD; HYPERLINK http://www.boldsystems.org) infrastructure were funded by Genome Canada through the Ontario Genomics Institute. The Animal Systematic Research Unit and Integrated Ecology Lab, Department of Biology, Faculty of Science, Chulalongkorn University kindly allowed use of their Cell^D® imaging facility.

References

Baker CF (1917) Ichneumonoid parasites of the Philippines. i. Rhogadinae. Philippines Journal of Science D12: 281–327.

Butcher BA, Smith MA, Quicke DLJ (2011) A new derived species group of *Aleiodes* parasitoid wasps (Hymenoptera, Braconidae, Rogadinae) from Asia with descriptions of three new species. Journal of Hymenoptera Research 23: 35–42.

Cameron P (1907) Hymenoptera of the Dutch expedition to New Guinea in 1904 an 1905. Part II: Parasitic Hymenoptera. Tijdschrift voor Entomologie 50: 27–57.

Chen X-X, He J-H (1997) Revision of the subfamily Rogadinae (Hymenoptera: Braconidae) from China. Zoologische Verhandelingen, Leiden 308: 1–187.

Craft KJ, Pauls SU, Darrow K, Miller SE, Hebert PDN, Helgen LE, Novotny V, Weiblen GD (2010) Population genetics of ecological communities with DNA barcodes: an example from New Guinea Lepidoptera. Proceedings of the National Academy of Sciences of the United States of America 107: 5041–5046.

Fortier JC (2000) Description of a new gregarious species of *Aleiodes* Wesmael (Hymenoptera: Braconidae: Rogadinae). Journal of Hymenoptera Research 9: 288–291.

Granger C (1949) Braconides de Madagascar. Memoires de l'Institut Scientifique de Madagascar (A) 2: 1–428.

Guinnee MA, Bernal JS, Bezemer TM, Fidgen JG, Hardy ICW, Mayhew PJ, Mills NJ, West SA (2005) Testing predictions of small brood models using parasitoid wasps. Evolution and Ecology Research 7: 779–794.

Hrcek J, Miller SE, Quicke DLJ, Smith MA (2011) Molecular detection of trophic links in a complex insect host-parasitoid food web. Molecular Ecology Resources 11: 786–794.

Kimmins DE (1962) Miss L.E. Cheesman's expeditions to New Guinea. Trichoptera. Bulletin of the British Museum (Natural History) Entomology 11: 99–187.

Maeto K, Arakaki N (2005) Gregarious emergence of *Macrostomion sumatranum* (Hymenoptera: Braconidae; Rogadinae) from the mummified, full-grown larvae of *Theretra silhetensis* (Lepidoptera: Sphingidae). Entomol Science 8: 131–132 doi: 10.1111/j.1479-8298.2005.00107.x

Mayhew PJ, Glaizot O (2001) Integrating theory of clutch size and body size evolution for parasitoids. Oikos 92: 372–376.

Mayhew PJ, van Alphen JJM (1999) Gregarious development in alysiine parasitoids evolved through a reduction in larval aggression. Animal Behaviour 58: 131–141.

Munroe EG (1974) New Pyralidae (Lepidoptera) from the Papuan region. III. Canadian Entomologist 106: 21–30.

Munroe EG (1996) Distributional patterns of Lepidoptera in the Pacific Islands. In: Keast A, Miller SE (Eds) The Origin and Evolution of Pacific Island Biotas, New Guinea to Eastern Polynesia: Patterns and Processes. Academic Publishers, Amsterdam, 275–295.

Quicke DLJ, Shaw MR (2005) First host record for the rogadine genus *Pholichora* van Achterberg (Hymenoptera: Braconidae) with description of a new species and notes on convergent wing venation features. Journal of Natural History 39: 531–537.

Quicke DLJ, Yen S-H, Mori M, Shaw MR (2003) First host records for the rogadine genus *Conspinaria* (Hymenoptera: Braconidae), and notes on Rogadinae as parasitoids of Zygaenidae (Lepidoptera). Journal of Natural History 38: 1437–1442.

Shaw MR (2002) A new species of *Macrostomion* Szépligeti (Hymenoptera: Braconidae: Rogadinae) from Papua New Guinea, with notes on the biology of the genus. Zoologische Mededelingen, Leiden 76: 133–140.

Shaw MR [2002] (2003) Parasitic Hymenoptera: Evolution, Systematics, Biodiversity and Biological Control. Melika G, Thuroczy C (Eds) Budapest: Agroinform. Host ranges of *Aleiodes* species (Hymenoptera: Braconidae), and an evolutionary hypothesis, 321–327.

Stamatakis A (2006) RAxML-VI-HPC: Maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. Bioinformatics 22: 2688–2690.

Szépligeti G (1911) Braconidae der I. Zentral-Afrika-Expedition. Wissenschaftliche Ergebnisse Deutschen Zentral-Afrika Expedition 3: 393–418.

Tenma K (2002) Newly Recorded Genera, *Conspinaria* Schulz, 1906 and *Colastomion* Baker, 1917 (Hymenoptera, Braconidae, Rogadinae) from Japan. Japanese Journal of Systematic Entomology 8: 185–191.

van Achterberg C (1979) A revision of the subfamily Zelinae auct. (Hymenoptera, Braconidae). Tidjschrift voor Entomologie 122: 241–479.

van Achterberg C (1988) Revision of the subfamily Blacinae Foerster (Hymenoptera, Braconidae). Zoologische Verhandelingen, Leiden 249: 1–324.

van Achterberg C (1989) Four new genera of Braconinae and Rogadinae from the Oriental Region (Hymenoptera: Braconidae). Zoologische Mededelingen, Leiden 63: 79–85.

van Achterberg C (1991) Revision of the genera of the Afrotropical and W. Palaeartica Rogadinae Foerster (Hymenoptera: Braconidae). Zoologische Verhandelingen, Leiden 273: 1–102.

van Achterberg C, Chen X (1996) *Canalirogas*, a new genus of the subfamily Rogadinae Foerster (Hymenoptera: Braconidae) from the Indo-Australian region. Zoologische Mededelingen, Leiden 70: 63–92.

Viette P (1987) Le cas de *Glyphodes stolalis* Guenée (Lep. Crambidae Spilomelinae). Lambillionea 87: 108–110.

Yu DS, van Achterberg C, Horstmann K (2005) World Ichneumonoidea 2004 – Taxonomy, Biology, Morphology and Distribution. Taxapad 2005. Vancouver.

Zaldivar-Riverón A, Shaw MR, Saez AG, Mori M, Belokobylskij SA, Shaw SR, Quicke DLJ (2009) Evolution of the parasitic wasp subfamily Rogadinae (Braconidae): phylogeny and evolution of lepidopteran host ranges and mummy characteristics. BMC Evolutionary Biology 8: 329.